



EMERGENCY COMMUNICATION AND TRACKING SYSTEMS

MSHA TECHNOLOGY EVALUATION

MSHA ACTIVITIES To ADDRESS COMMUNICATION AND TRACKING ISSUES

- Investigate Mine Site Technologies PED and TRACKER systems
- Evaluate available new technology
 - Received more than 100 proposals
 - Requested proposals through www.msha.gov
 - Reviewed proposals to determine which to pursue further

MINE SITE PED AND TRACKER INVESTIGATION

- Investigate PED installations at:
 - Peabody Air Quality and Twentymile Mines
 - Consol Blacksville and Robinson Run Mines
 - BHP San Juan Mine (only surface-installed antenna in the US)
- Traveled to Australia to investigate TRACKER installation

PROS AND CONS OF PED

- Pros:
 - Can send evacuation instructions to miners in early stages of fire
 - Can be retrofit for Koehler, NLT and MSA cap lamps
 - System can be deployed in emergency by arranging surface loop antenna
- Cons:
 - Underground antenna could be compromised in fire or explosion
 - Reports of some areas where signals can't be received (shadow zones)
 - Can interfere with existing mine systems
 - Communications limited to one-way
 - No confirmation that message has been received

PROS AND CONS OF TRACKER

- Pro: Can provide last known location of miner before loss of power
- Cons:
 - Cannot provide precise location of personnel
 - System will become non-operational upon loss of power

SYSTEM EVALUATION CRITERIA

- System capability – precise tracking and 2-way voice and text preferred
- Survivability in a fire or explosion
 - Focusing on completely wireless communication
- Current availability
 - Available or near term available hardware vs. conceptual
- Capability of complying with MSHA requirements

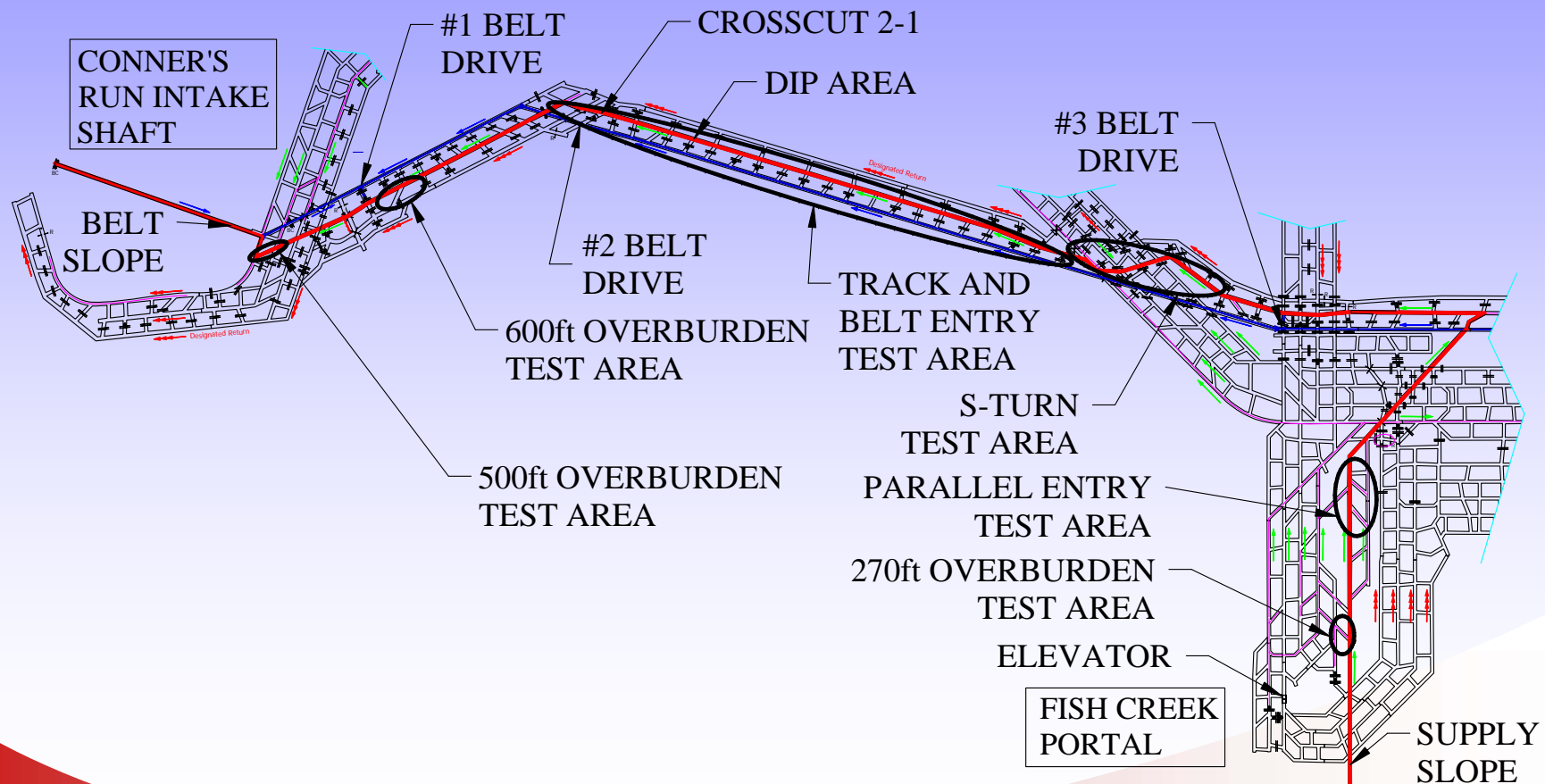
FIELD TESTING EVALUATION GOALS

- Determine how well signals propagate (maximum distance between nodes)
- Determine how much overburden systems can penetrate if capable of through-the-earth communication
- Determine mine coverage area (i.e. are there blind spots and why?)
- Explore interference issues
- Determine accuracy of tracking features

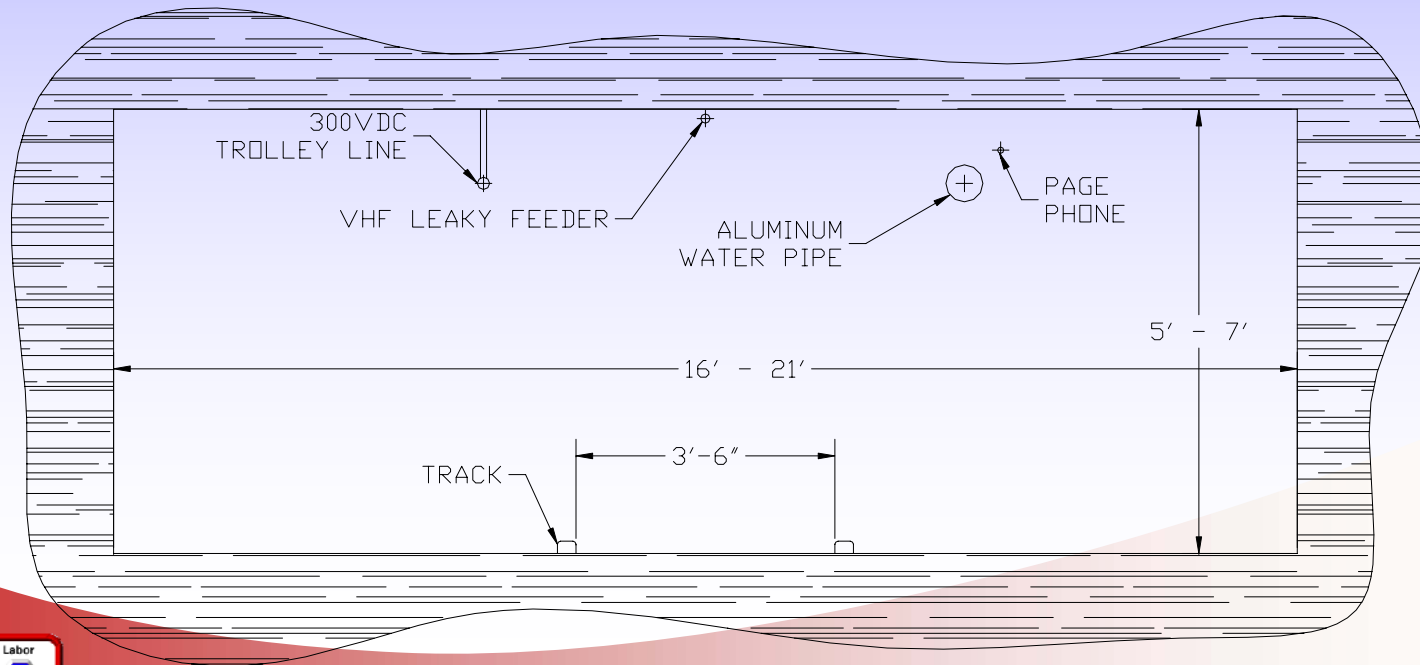
CURRENT TECHNOLOGIES UNDER EVALUATION

- Wireless node-based (wi-fi) systems
 - Rajant Breadcrumb™ System
 - Innovative Wireless technologies
- Ultra-Wide Band (UWB) Communications and Tracking
 - Concurrent Technologies Corporation / Time Domain
- Low frequency, narrow band through-the-earth (TTE)
 - Transtek
 - Gamma Services, Inc.
- Medium Frequency
 - Kutta Consulting

Testing at McElroy Mine



Track Entry



Belt Entry



Rajant Breadcrumb™



BreadCrumb® XL



BreadCrumb® XLV



BreadCrumb® WE

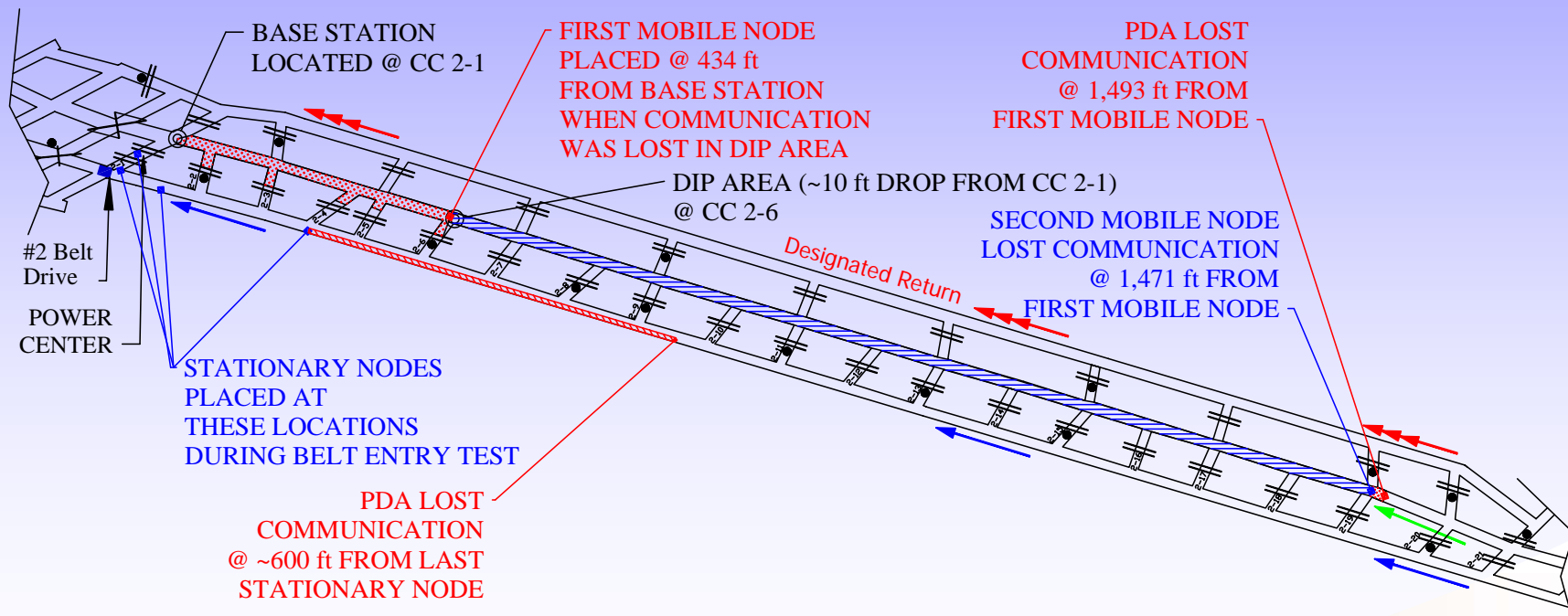


BreadCrumb® SE

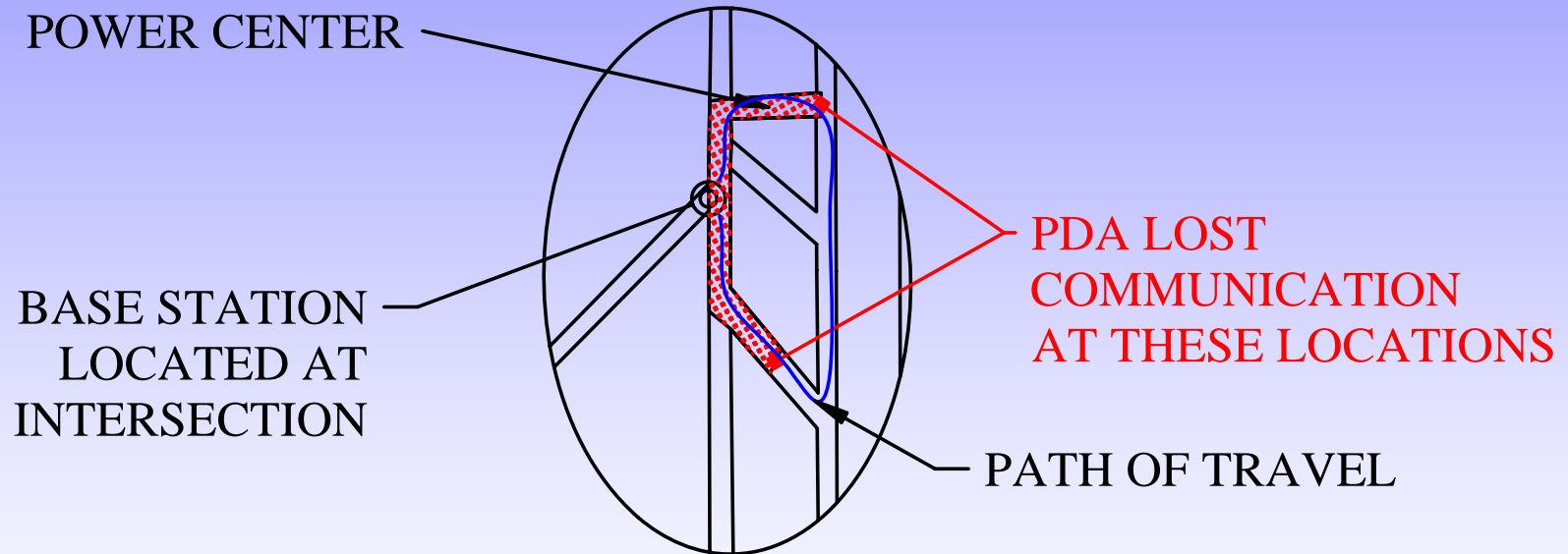


BreadCrumb® ME

Rajant Breadcrumb™

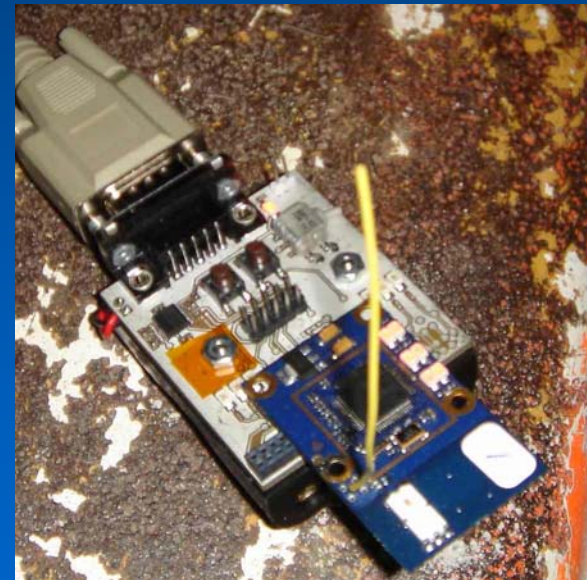
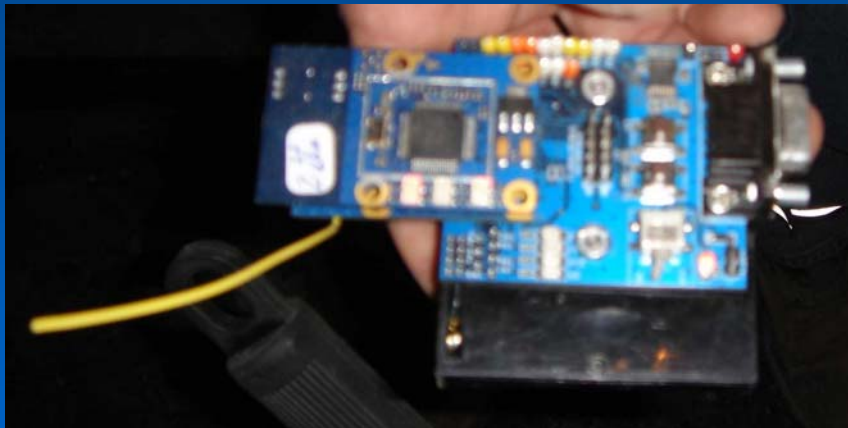


Rajant Breadcrumb™



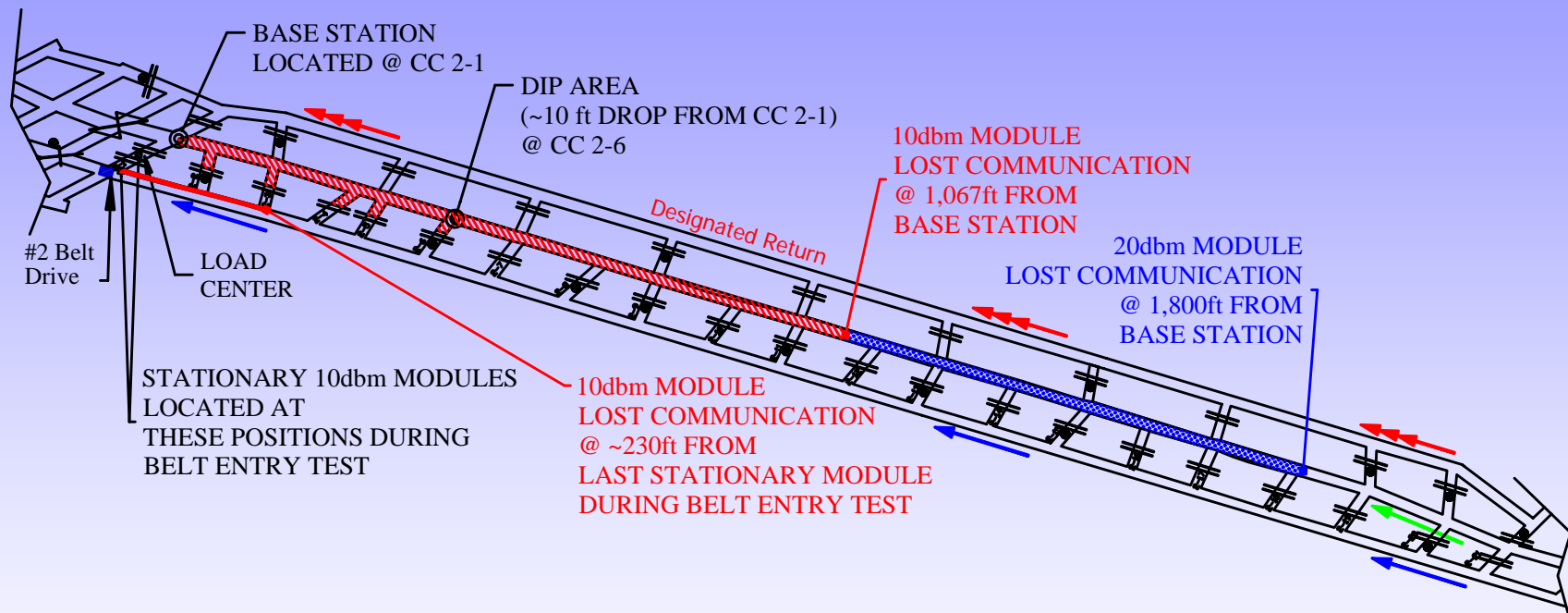
Innovative Wireless Technologies

AXON Nodes



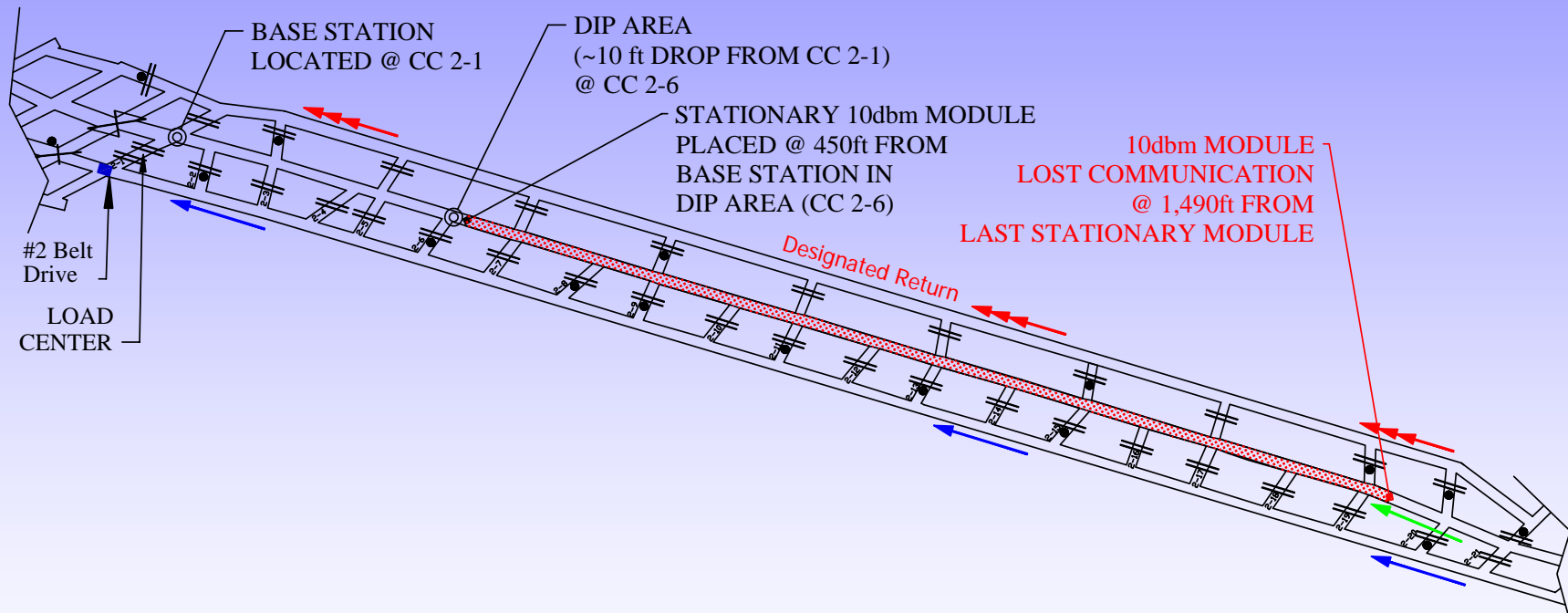
Innovative Wireless Technologies

AXON Nodes



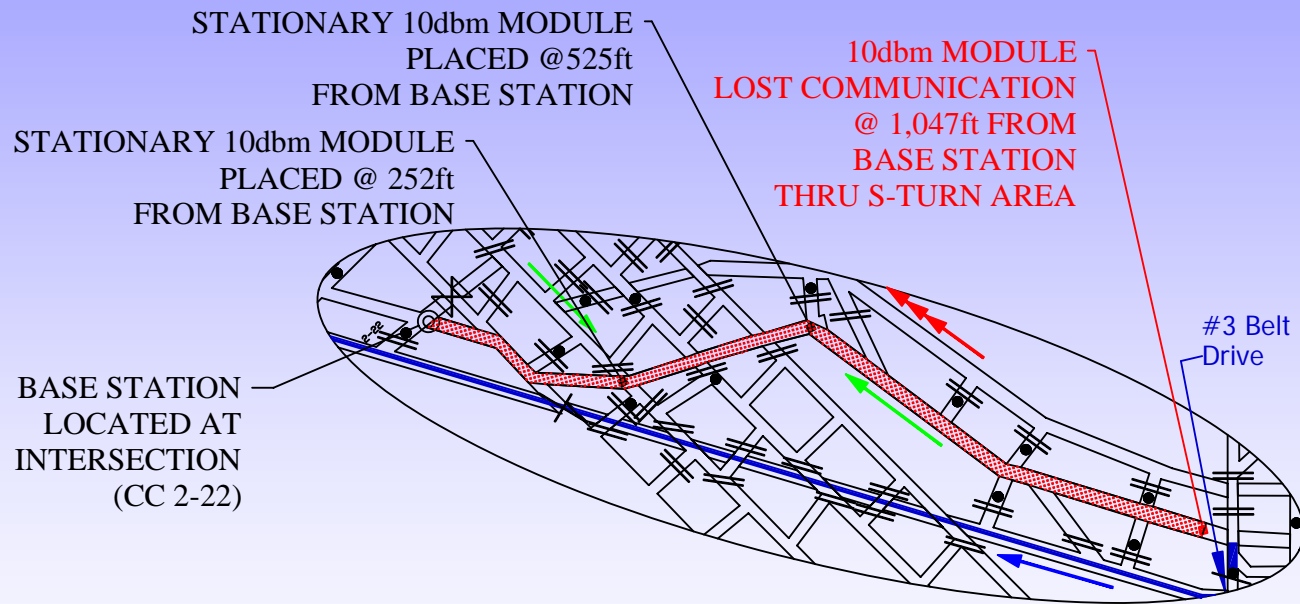
Innovative Wireless Technologies

AXON Nodes



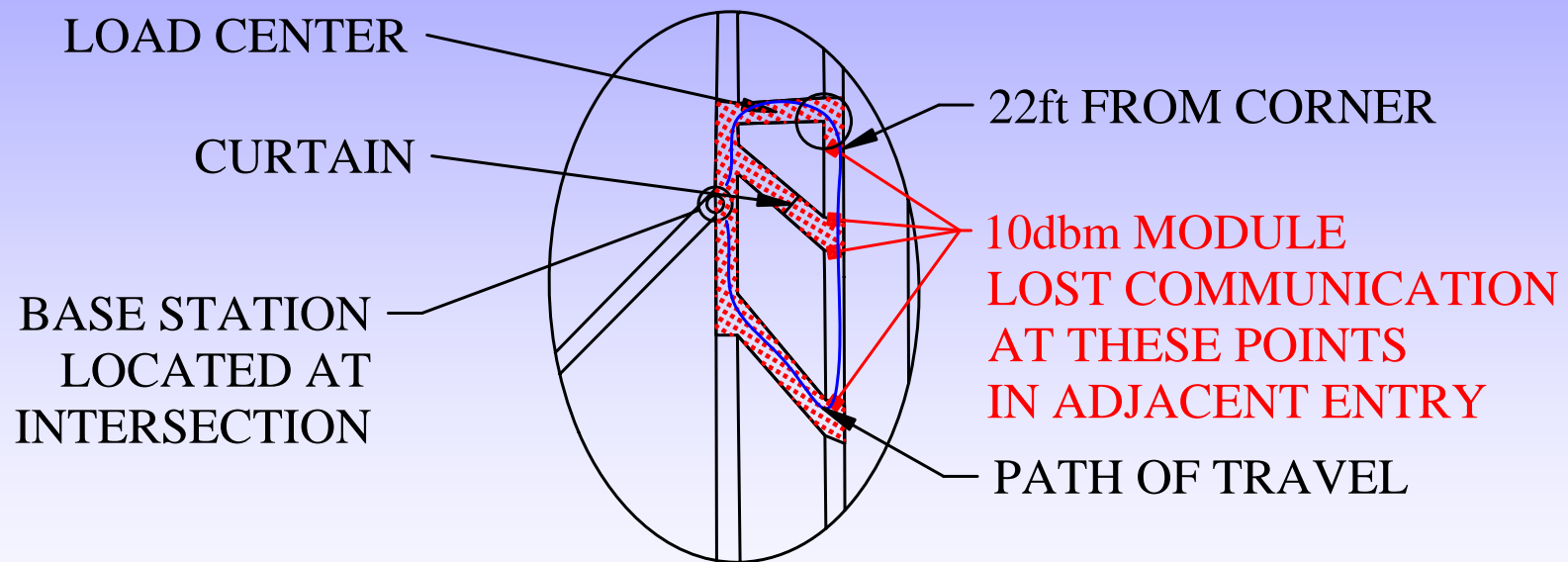
Innovative Wireless Technologies

AXON Nodes



Innovative Wireless Technologies

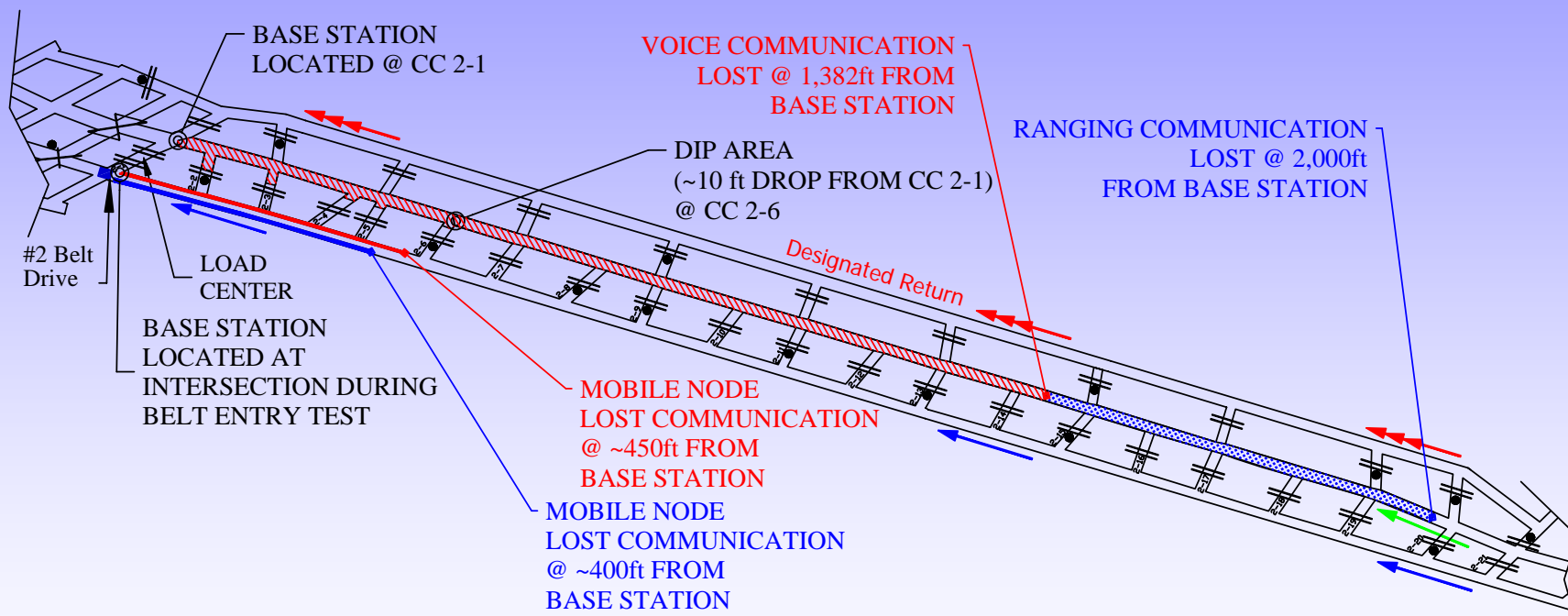
AXON Nodes



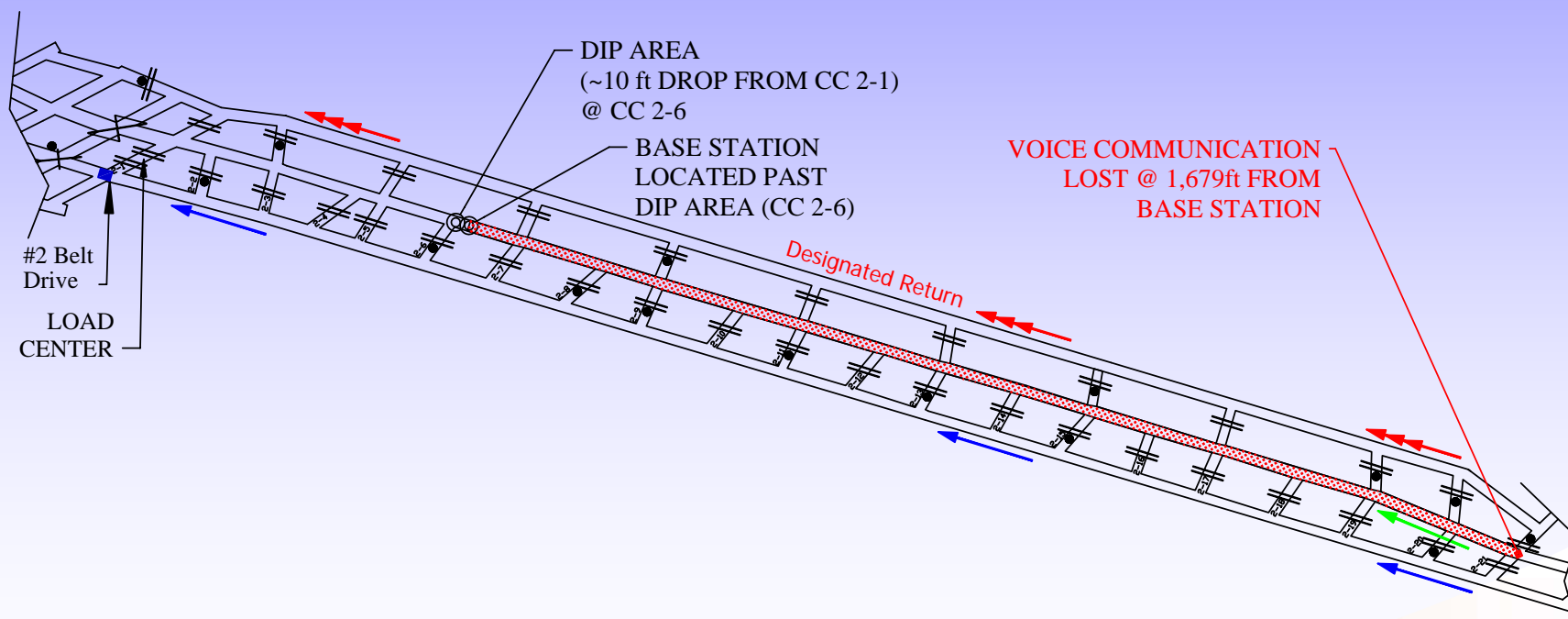
Concurrent Technologies Corporation / Time Domain



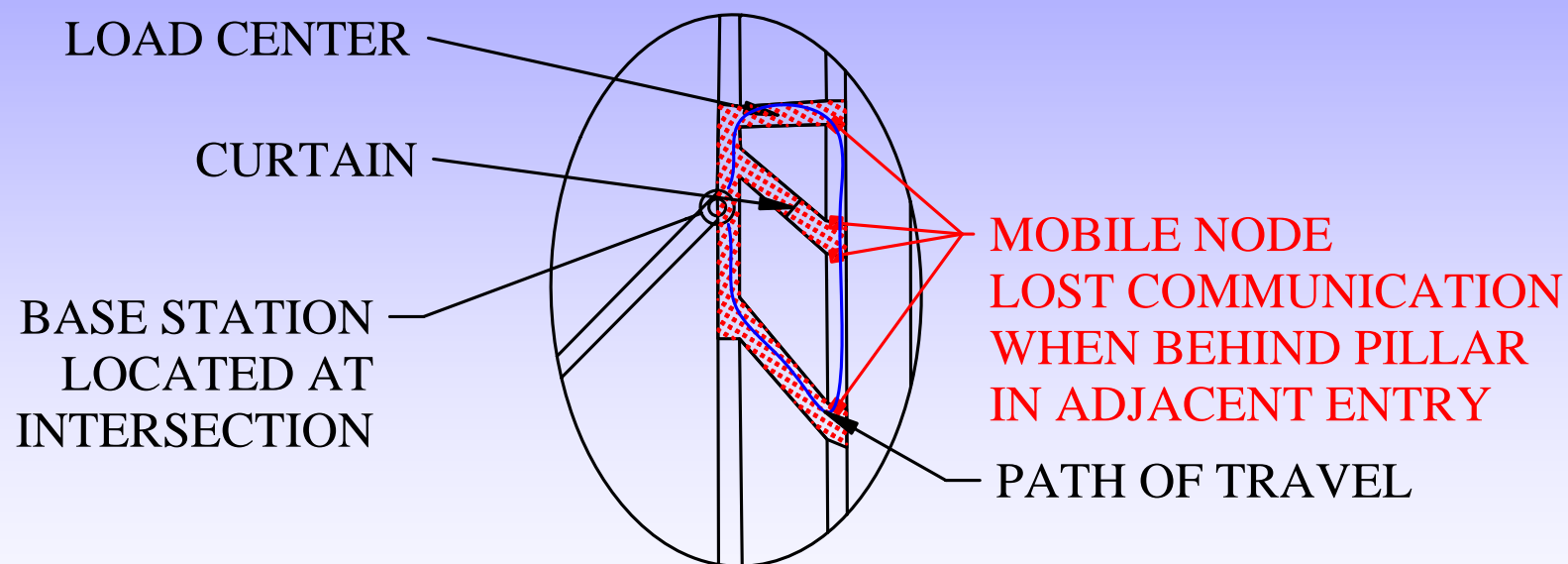
Concurrent Technologies Corporation / Time Domain



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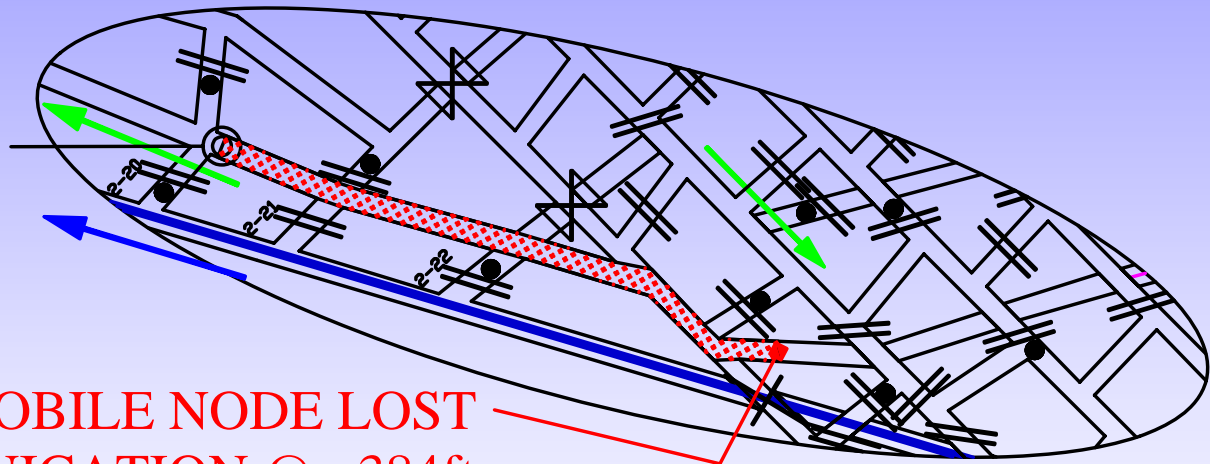
Concurrent Technologies Corporation / Time Domain



Concurrent Technologies Corporation / Time Domain

BASE STATION
LOCATED AT
INTERSECTION

MOBILE NODE LOST
COMMUNICATION @ ~384ft
FROM BASE STATION IN S-TURN



Transtek Telemag

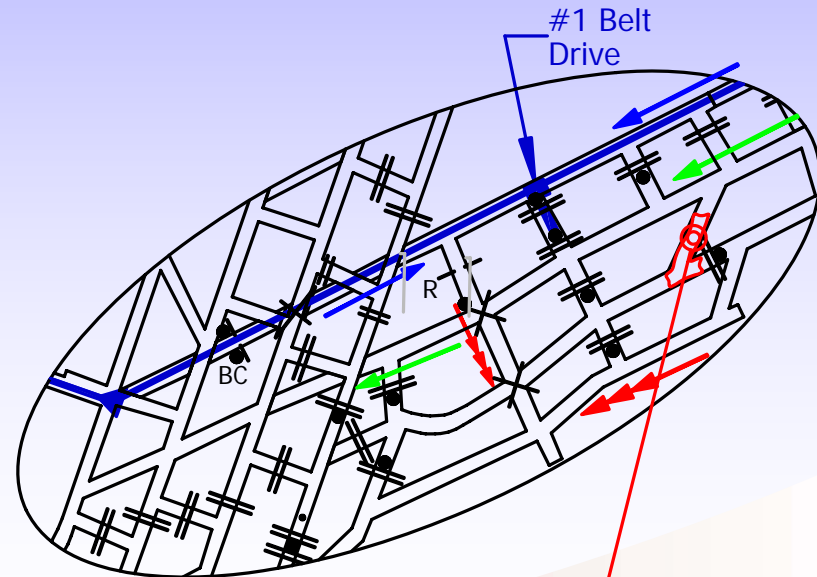
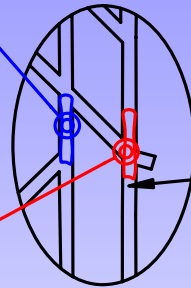


Transtek Telemag

RADIO AND LOOP ANTENNA
MOVED TO ADJACENT
TRACK ENTRY
~170ft FROM 270ft
OVERBURDEN POINT

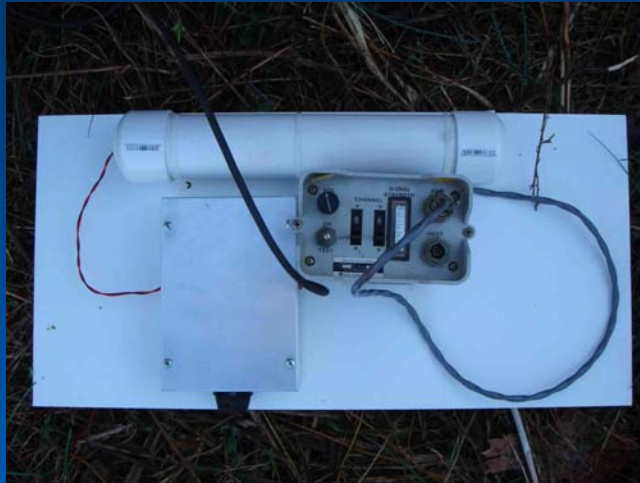
**RADIO AND LOOP ANTENNA
LOCATED @ INTERSECTION
~270ft OF OVERBURDEN**

- BOTTOM OF SUPPLY SLOPE

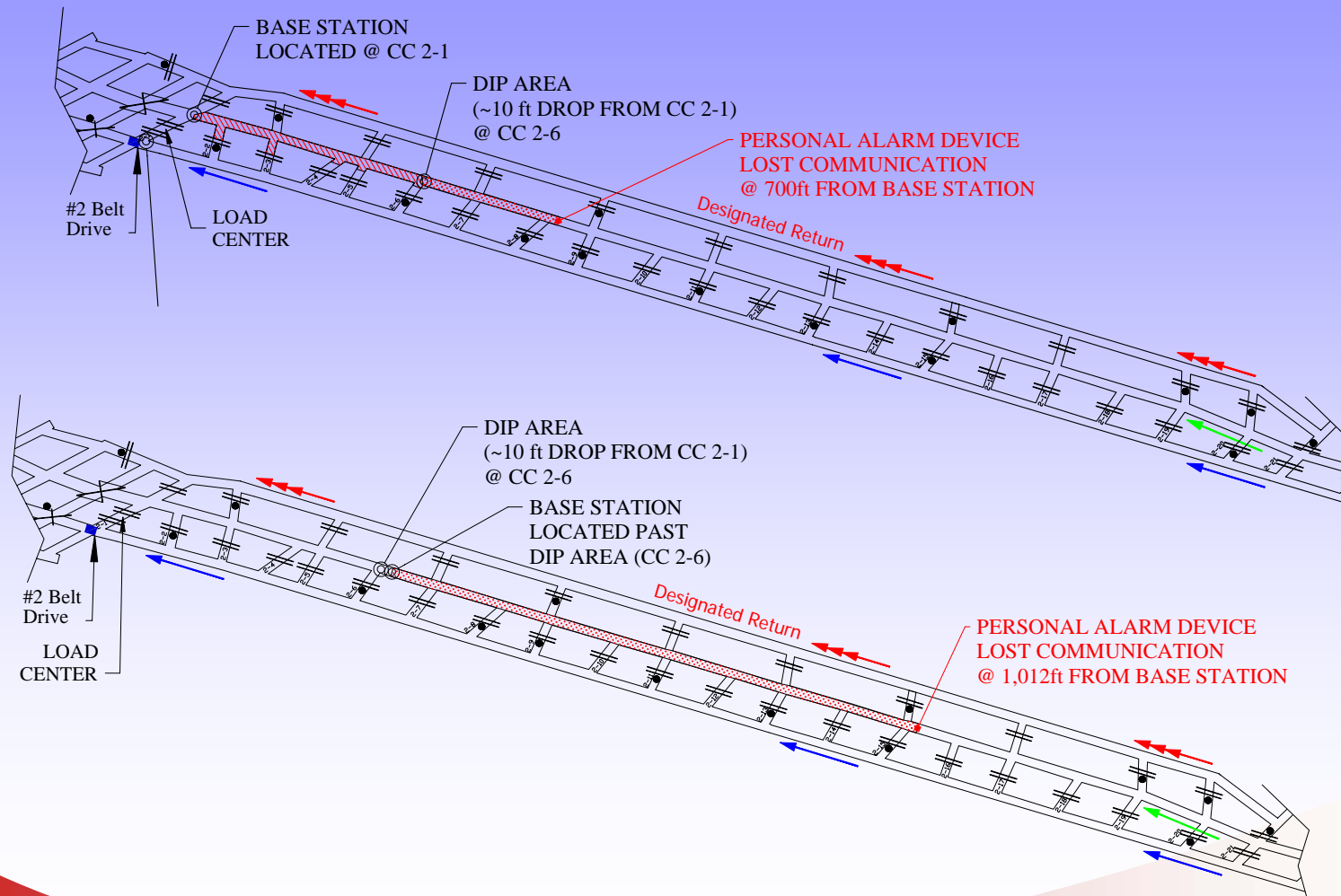


**RADIO AND LOOP ANTENNA
LOCATED IN CROSSCUT
AND ADJACENT ENTRY
~600ft OF OVERBURDEN**

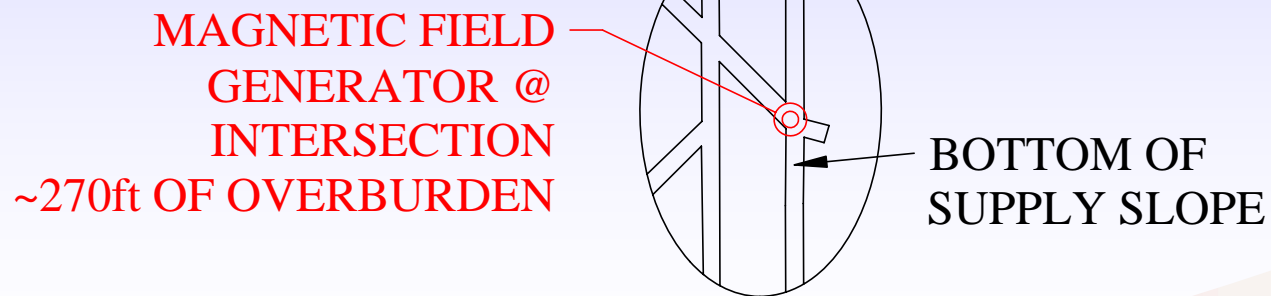
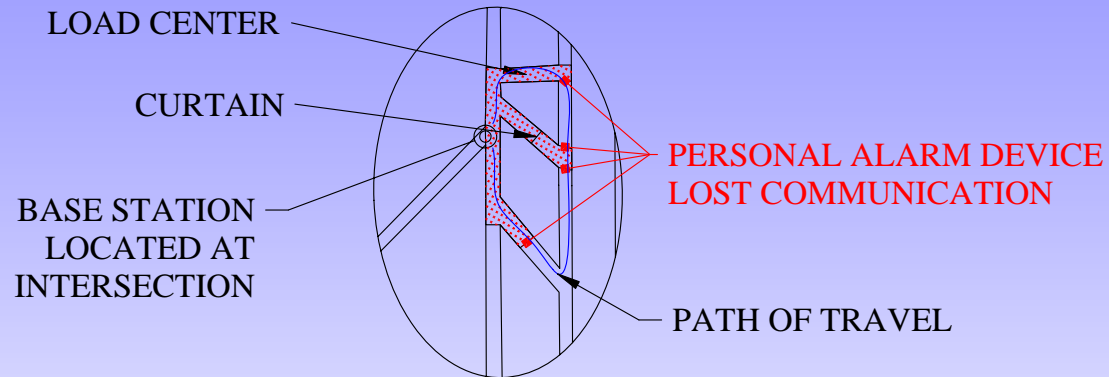
Gamma Services, Inc.



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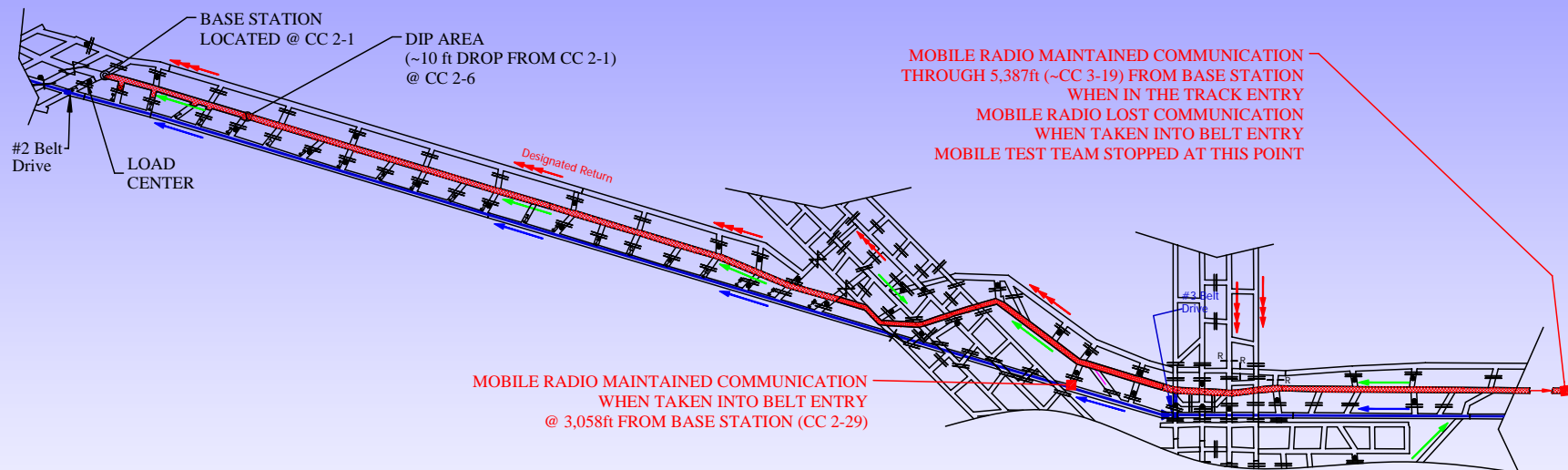
Gamma Services, Inc.



Kutta Consulting

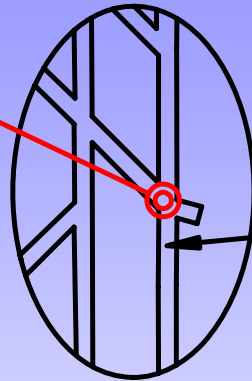


Kutta Consulting

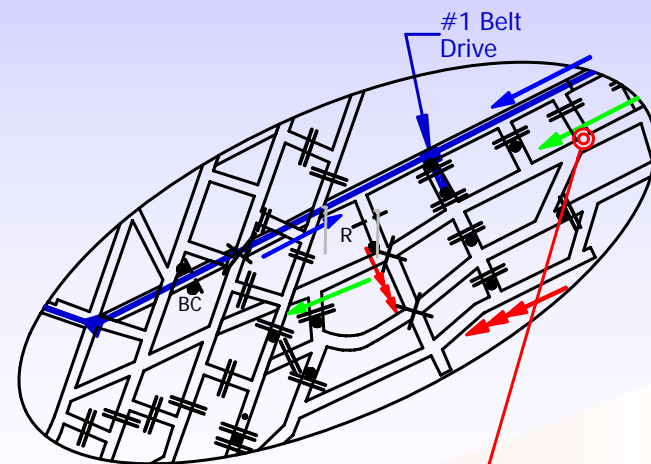


Kutta Consulting

BEACON AND
RADIO LOCATED @
INTERSECTION
~270ft OF OVERBURDEN



BOTTOM OF
SUPPLY SLOPE



BEACON AND RADIO
LOCATED IN CC 1-3
~600ft OF OVERBURDEN